

MEMORANDUM

To: Benchmarking Subcommittee of the Air Toxics Advisory Committee (ATAC)

From: David Wright, Section Chief – Air Toxics and Emissions Inventory, BAQC, MEDEP

Date: December 3, 2004

RE: Draft Benchmarking Narrative for your review and comment

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1. BACKGROUND

As part of the Maine Air Toxics Initiative (MATI), the Inventory and Toxicity Subcommittees are developing an Air Toxics Priority List (ATPL) for Maine, based on toxicity-weighted emissions of Air Toxics (ATs). This approach was used because MEDEP and ATAC did not have the resources to run the sophisticated models that would be needed for a detailed assessment, such as the one EPA used in the National Air Toxics Assessment (NATA).¹ Instead, ATAC estimated Air Toxic priorities based on the volume released and chemical toxicity, as shown in Equation 1.

Equation 1: Conversion of Volumetric Rank to Risk Weighted Emission

$$R_p = V_p * T_p$$

Where: p = one of *n* Air Toxic Pollutants

R_p = Risk Weighted Emission of Air Toxic “P” (risk pounds-pollutant “P” / year)

V_p = Volumetric Release of Air Toxic P (pounds-pollutant “P”/ year)

T_p = Toxicity Factor of Air Toxic “P” from RSEI (unitless)

Example Calculation:

Let:

p = Total Acrolein

V_p = 134,445 (pounds-pollutant “P”/ year)

T_p = 90,000(unitless)

Therefore:

$$R_p = V_p * T_p = 134,445 * 90,000 = 12,100,050,000$$

Inventory: The volume of AT released in Maine is based on an update to the National Emission Inventory (NEI) for 1999. Like most air emission inventories, the NEI is subdivided into four major categories: point sources, area sources, mobile sources, and background sources. The Inventory Subcommittee of ATAC reviewed all of the categories of emissions, resulting in significant changes in the estimated release of many Air Toxics, as compared to the 1999 NEI.

¹ Details on the NATA are available from EPA’s Air Toxics Website at: <http://www.epa.gov/ttn/atw/nata/>.

The inventory of Maine HAP emissions that the subcommittee developed is known as the “2002 MATI inventory”.

Toxicity: To assess toxicity, ATAC used the toxicity factors in EPA’s Risk-Screening Environmental Indicators (RSEI) model. The Toxicity Subcommittee of the ATAC updated some of these factors based on toxicological information that EPA has revised since publication of the RSEI toxicity factors. The toxicity subcommittee also developed risk factors for total Polycyclic Organic Matter (POM), Dioxin, and Diesel Particulate Matter (DPM).

Acceptable Risk: Ultimately, the goal of the MATI is to focus resources only on those ATs that pose unacceptable risks. Generally, the MEDEP Air Bureau defines acceptable risks as risks below a Health Quotient (HQ) of 1 (for non-carcinogens)², and below an Incremental Lifetime Cancer Risk (ILCR) of one in a million (for carcinogens)³. It should be noted that in using the RSEI factors, ATAC equated a noncancer threshold with an incremental cancer risk of 2.5×10^{-4} . Thus the cancer risk of Air Toxics was given 250 times less weight than MEDEP usually considers for air programs.

2. ASSESSING WHICH RANKED COMPOUND POSE UNACCEPTABLE RISK

Benchmarking Using the 1996 NATA: The above process prioritizes the ATs relative to each other, but does not determine which pollutants may currently be posing an actual risk problem. To address this issue, the Benchmarking Subcommittee will compare the ATAC’s ranked list to the 32 compounds assessed in the 1996 National Air Toxics Assessment, which did quantify risk. In this way the Benchmarking Subcommittee will be able to calibrate, or benchmark, Maine’s AT priority list to actual risk levels. The subcommittee is using the 1996 NATA, since it is the most recent, publicly available, statewide risk assessment.

The primary issue that the subcommittee is addressing is that the NATA modeling done using 1996 emission data does not accurately represent existing conditions. The current emission inventory is substantially different from the 1996 HAP emission inventory. If the 1996 NATA emission input values do not represent current emissions, the resultant risk determinations will also not represent current conditions. Therefore, the subcommittee discussed the possibility of applying the ratio of current emissions and 1996 emissions to the 1996 NATA risk, to obtain the current risk. EPA⁴ thought that this was feasible, since the NATA modeling is generally linear.

² MEDEP uses the Health Quotient (HQ) to determine if a non-carcinogen will pose a risk to a person or population, after they are exposed to that compound over a certain amount of time, usually a lifetime. Below a HQ of 1, no adverse effects will occur, above a HQ of 1, adverse health effects may occur. Specifically, MEDEP estimates the HQ by taking the Average Daily Dose for the chronic exposure period, and dividing it by the chronic Reference Dose.

³ MEDEP defines the Incremental Lifetime Cancer Risk (ILCR) as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a chemical. ILCR is estimated by multiplying the Average Daily Dose over a lifetime by the Cancer Potency Factor. For more information on deriving HQ and ILCR, see Chapter 5 of MEDEP and MEDHS, “Guidance Manual for Human Health Risk Assessments at Hazardous Substance Sites”, June 1994 (Denise Messier, BRWM-MEDEP, 17 SHS, Augusta, ME 04333-0017; 207-287-2651; Denise.L.Messier@maine.gov).

⁴ Ted Palma at Office of Air Quality and Program Standards in Research Triangle Park, in a teleconference with the benchmarking subcommittee on August 3, 2004.

To adjust the 1996 NATA risk results to the current 2002 MATI Inventory, the benchmarking subcommittee will use the following equations

Equation 2: Adjusting the 1996 NATA risk to 2002 MATI inventory emissions

$$2002 \text{ Risk} / 2002 \text{ Inventory} = 1996 \text{ Risk} / 1996 \text{ Inventory}$$

Cross multiply to obtain:

$$P_{2002 \text{ Risk}} = P_{2002 \text{ Inventory}} * P_{1996 \text{ Risk}} / P_{1996 \text{ Inventory}}$$

Where:

$P_{2002 \text{ Risk}}$	Is the risk posed by a pollutant in a given county based on 2002 emissions. For carcinogens, the risk is expressed as an Incremental Life- Time Cancer Risk (ILCR). For Non-carcinogens, the risk is expressed as a Hazard Quotient (HQ).
$P_{2002 \text{ Inventory}}$	Is the 2002 Hazardous Air Pollutant (HAP) inventory developed for the Maine Air Toxics Initiative (MATI). The inventory was developed by the Inventory Subcommittee of the Maine Air Toxics Advisory Committee (ATAC).
$P_{1996 \text{ Risk}}$	Is the risk posed by a pollutant in a given county based on 1996 emissions, as modeled for the National Air Toxics Assessment (NATA). For carcinogens, the risk is expressed as an ILCR. For Non-carcinogens, the risk is expressed as an HQ.
$P_{1996 \text{ Inventory}}$	Is the 1996 HAP emissions inventory that was used as model inputs for the NATA.

Risk from “Background” Concentrations: The 1996 NATA included in the overall risk, the risk posed by background concentrations of the pollutants listed in Table 1. These concentrations were intended to account for “long-range transport, resuspension of historical emissions, and nonanthropogenic sources”, which were not included in the emissions inventory. For this benchmarking, the subcommittee will assume that the risk due to background concentrations in 2002 will be equal to the risks due to background in 1996, as shown in Equation 3.

Equation 3: Risk from Background Concentrations of Pollutants

$$P_{2002 \text{ Risk from Background}} = P_{1996 \text{ Risk from Background}}$$

Where:

$P_{2002 \text{ Risk from Background}}$	Is the year 2002 risk that is posed by a pollutant in a given county based on background concentrations. For carcinogens, the risk is expressed as an ILCR. For Non-carcinogens, the risk is expressed as a HQ.
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$P_{1996 \text{ Risk from Background}}$ Is the risk posed by a pollutant in a given county based on 1996 based on background concentrations, as modeled for the National Air Toxics Assessment (NATA). For carcinogens, the risk is expressed as an ILCR. For Non-carcinogens, the risk is expressed as a HQ.

Table 1: Background Pollutant Concentration used by EPA in the 1996 NATA

Pollutant	Background Concentration ($\mu\text{g}/\text{m}^3$)
Benzene	0.48
Carbon tetrachloride	0.88
Chloroform	0.083
Ethylene dibromide	0.0077
Ethylene dichloride	0.061
Formaldehyde	0.25
Hexachlorobenzene	0.000093
Mercury compounds	0.0015
Methylene chloride	0.15
Polychlorinated biphenyls	0.00038
Perchloroethylene (Tetrachloroethylene)	0.14
Trichloroethylene	0.081

Over-all Risk from each Pollutant in each county: Risk is assessed for each pollutant, in each county for the following sectors: Point, Area, Mobile/off-road, Mobile/on-road, and background. The total risk from each pollutant in each county is derived by summing each category using Equation 4. Carcinogens and non-carcinogens are assessed separately.

Equation 4: Total Risk for Each Pollutant in Each County

$$P_{\text{Total}} = P_{\text{Point}} + P_{\text{Area}} + P_{\text{non-road}} + P_{\text{onroad}} + P_{\text{background}}$$

Where:

P_{Total} Is the Total Risk (expressed as either a HQ or ILCR) for pollutant P in each county

P_{Point} Is the Risk from point source emissions (expressed as either a HQ or ILCR) for pollutant P in each county

P_{Area} Is the risk from area source emissions (expressed as either a HQ or ILCR) for pollutant P in each county

$P_{\text{non-road}}$ Is the risk from non-road source emissions (expressed as either a HQ or ILCR) for pollutant P in each county

P_{onroad} Is the risk from onroad source emissions (expressed as either a HQ or ILCR) for pollutant P in each county

$P_{\text{background}}$ Is the risk from background concentrations (expressed as either a HQ or

ILCR) for pollutant P in each county

Other Factors: Once the ranking is done, the priority list must also be viewed considering these additional factors:

1. lack of emissions data from certain source categories;
2. uncertainty in using a toxicity-weighted emissions approach rather than a full risk assessment;
3. the under-weighting of carcinogens by the RSEI toxicity factors;
4. impacts from mixtures of chemicals; and
5. the uncertainties in the factors used in the ranking, and described in detail in the basis statement.

Benchmarking Narrative.doc